ARCHAEOLOGICAL SERVICES
DURHAM UNIVERSITY

on behalf of
Altogether Archaeology

St Botolph's Chapel
Frosterley
County Durham

geophysical survey

report 3215
July 2013

Durham University

Contents

Figures

South Road · Durham · DH1 3LE · tel 0191 334 1121 · fax 0191 334 1126
archaeological.services@durham.ac.uk · www.dur.ac.uk/archaeological.services

1. Summary

The project

1.1 This report presents the results of geophysical surveys conducted as part of the 'Altogether Archaeology' community project at the site of St Botolph's Chapel in Frosterley. The works comprised approximately 0.3ha of earth resistance and geomagnetic survey.

1.2 The works were commissioned by the North Pennines AONB, through Durham County Council, and conducted by Archaeological Services Durham University.

Results

1.3 An area of relatively high resistance was detected, covering the mound and much of the northern part of the field. This may be due, in part at least, to better drainage here, but much will almost certainly be due to the presence of near-surface rubble; some bands of stone rubble were evident on the surface. Within this general area it is possible to identify broad, irregular bands of particularly high resistance which almost certainly reflect deposits of stone rubble; these may overlie or be adjacent to the former walls of the chapel. Narrow high resistance anomalies could reflect *in situ* wall footings.

1.4 Some additional narrow high resistance anomalies, and occasional negative magnetic anomalies, on the southern and western slopes of the mound could possibly reflect further stone features and possible wall footings.

1.5 Two discrete anomalies on the southern edge of the mound probably reflect fired or burnt materials.

1.6 Two probable stone features were also detected aligned broadly north-south in the southern half of the field. The western feature may comprise a stone surface such as a track, while the eastern feature appears to be a stone-built ramp or track between the chapel site and the road. This latter feature can be discerned on the ground.

1.7 Several more subtle anomalies in both datasets could reflect the remains of soil-filled ditches and gullies or wall trenches.

1.8 A ferrous pipe has been detected across the southern part of the site.

2. Project background

Location (Figure 1)

2.1 The survey area comprised a parcel of land at Chapel Close in Frosterley, Weardale, County Durham, containing the presumed site of St Botolph's Chapel (NGR centre: NZ 02534 36990). Earth resistance and geomagnetic surveys were undertaken over the whole field, measuring approximately 0.3ha. The field is bounded by a recent housing development to the north and east, housing and a car park to the south, and garages and a former access track to the west.

2.2 Within the northern half of the field is the Scheduled Monument 'St Botolph's Chapel, 280m north of east of Frosterley Bridge, Frosterley, County Durham' (Monument no. 1016466).

Objectives

2.3 The principal aims of the survey were twofold: to determine the nature and extent of any sub-surface features of potential archaeological or historic significance, particularly any which might have been associated with the chapel, and to provide an opportunity for members of the North Pennines AONB 'Altogether Archaeology' project to receive training and engage in local heritage research.

Methods statement

2.4 The surveys have been undertaken in accordance with instructions from the client (North Pennines AONB), a methods statement provided by Archaeological Services Durham University, and national standards and guidance (see para. 5.1 below).

2.5 Since the study area included a Scheduled Monument the geophysical surveys were also undertaken in accordance with a 'section 42' licence granted by English Heritage under the Ancient Monuments and Archaeological Areas Act 1979 (as amended by the National Heritage Act 1983).

Dates

2.6 Fieldwork was undertaken on the 11th and 12th July 2013. This report was prepared for 29th July 2013.

Personnel

2.7 Fieldwork was conducted by members of the North Pennines AONB Altogether Archaeology project with assistance from Duncan Hale (the Project Manager) and Ashley Hayes (Supervisor) of Archaeological Services. The geophysical data were processed by Duncan Hale. This report was prepared by Duncan Hale with illustrations by Janine Watson and Linda Bosveld.

Archive/OASIS

2.8 The site code is **FSB13**, for **F**rosterley **S**t **B**otolph's Chapel 20**13**. The survey archive will be supplied on CD to the client for deposition with the project archive in due course. Archaeological Services Durham University is registered with the **O**nline **A**cces**S** to the **I**ndex of archaeological investigation**S** project (**OASIS**). The OASIS ID number for this project is **archaeol3-155797**.

Acknowledgements

2.9 Archaeological Services is grateful to Paul Frodsham of North Pennines AONB, the landowner and English Heritage for facilitating this research.

3. Historical and archaeological background

3.1 Trial archaeological excavations were undertaken at three locations in the field in 1995 (Archaeological Services 1995). The following information is taken from that evaluation report and from the English Heritage scheduled monument list entry.

3.2 The excavations uncovered the east end of a rectangular stone building standing to a maximum height of two courses (Archaeological Services 1995). An earthwork bank was initially targeted but this proved to be a bank of rubble, parallel with and outside the east wall of the rectangular structure. The presence of a robbed floor was inferred from an internal sand deposit and the remains of painted wall plaster survived *in situ* at the base of the walls. Painted plaster would have been rare in any medieval structure other than a chapel, church or manor house (*ibid*.). It was considered that this evidence, together with the rectangular, narrow shape of the earthwork, made the structure a very strong candidate for St Botolph's Chapel. The excavation also uncovered evidence of stone-robbing and several phases of demolition. Potsherds of 18th and 19th-century date were recovered from post-demolition deposits.

3.3 A substantial deposit of stone rubble was recorded in a trench to the south of the chapel mound. It was postulated that this could possibly be associated with the construction of a ramp from the road up to the chapel for stone-robbing (*ibid*.). Medieval pottery of Tees Valley Ware was recovered from this deposit, providing a 13th or 14th-century date, though the sherds may have been residual. Beneath the rubble were colluvial deposits, which sealed what appeared to be a wall trench, though the stone had either been robbed or the wall had never been built.

3.4 No structures or features were found in a trench to the west of the presumed chapel though abraded sherds dating to the 11th-13th centuries were recovered.

3.5 Further to the 1995 evaluation it was determined that:
"St Botolph's Chapel at Frosterley survives well and retains significant archaeological deposits. It is of particular importance as it is the most northerly church dedicated to St Botolph and is a rare example of its type."
(http://list.english-heritage.org.uk/resultsingle.aspx?uid=1016466)

3.6 The list entry continues:
"The monument includes the remains of a chapel of medieval date, situated in the village of Frosterley on a flat site overlooking steep slopes to the south. The chapel is visible as the earthwork remains of an oval mound orientated east to west measuring 30m by 22m, surmounted by a rectangular structure 18m by 7.5m. It stands to a maximum height of 1.4m at the western end where it is best preserved. The place name Frosterley is first mentioned in the Boldon Book in 1183 and specific mention of a chapel at Frosterley is first mentioned in a document of 1346. It is thought that the chapel may have originated many centuries earlier and the discovery of a copper alloy strap end of 9th-century date during house construction to the north of the chapel testifies to early activity in the vicinity. The chapel is believed to have been dedicated to St Botolph, the 7th-century Anglo-Saxon saint considered to have been one of the pioneers of Benedictine rule in England. As late as 1522, the chapel was still in use, but by the late 18th century it was described as 'disused' and 'gone to decay'".

3.7 The site has great potential for contributing to the knowledge and understanding of the establishment and spread of the Christian Church in England.

4. Landuse, topography and geology

4.1 The field is normally used for donkey pasture. Although not grazed at the time of fieldwork the vegetation did not pose a problem for the surveys. The unusually dry ground conditions, however, did hinder the collection of resistance data.

4.2 The field occupies a gentle south-facing slope on the north side of the River Wear with elevations between approximately 177-183m OD. There is a clear mound in the north of the field, on which both earthworks and stone rubble are evident; this is the presumed site of the chapel.

4.3 South of the mound, and to the south-east, the land slopes away with alternate steep and shallow gradients, creating subtle terraces; three terraces are apparent in the eastern half of the field. Two earthwork banks are evident on the ground heading south from the mound. The eastern bank is relatively short, however, the western bank can be traced as far as the level ground in the south of the field; it is this feature which has been postulated as a possible ramp built to assist with stone-robbing.

4.4 The underlying solid geology of the area comprises Visean-Namurian limestone of the Alston Formation, which is overlain by Quaternary river terrace deposits. The famous 'Frosterley Marble' is sourced just north and north-west of the site in Rogerley Quarry.

5. Geophysical survey

Standards

5.1 The surveys and reporting were conducted in accordance with English Heritage guidelines, *Geophysical survey in archaeological field evaluation* (David, Linford & Linford 2008); the Institute for Archaeologists (IfA) *Standard and Guidance for archaeological geophysical survey* (2011); the IfA Technical Paper No.6, *The use of geophysical techniques in archaeological evaluations* (Gaffney, Gater & Ovenden 2002); and the Archaeology Data Service *Guide to Good Practice: Geophysical Data in Archaeology* (Schmidt & Ernenwein 2011).

Technique selection

5.2 Geophysical survey enables the relatively rapid and non-invasive identification of sub-surface features of potential archaeological significance and can involve a suite of complementary techniques such as magnetometry, earth electrical resistance, ground-penetrating radar, electromagnetic survey and topsoil magnetic susceptibility survey. Some techniques are more suitable than others in particular situations, depending on site-specific factors including the nature of likely targets; depth of likely targets; ground conditions; proximity of buildings, fences or services and the local geology and drift.

5.3 In this instance, based on previous work, it was known that the remains of both cut and built features, such as pits and wall foundations, would be present on the site.

5.4 Given the shallowness of targets and the presence of building remains, an electrical resistance survey was considered appropriate. Earth electrical resistance survey can be particularly useful for mapping stone and brick features, and is not affected by the presence of adjacent buildings or ironwork. When a small electrical current is injected through the earth it encounters resistance which can be measured. Since resistance is linked to moisture content and porosity, stone and brick features will give relatively high resistance values while soil-filled features, which typically retain more moisture, will provide relatively low resistance values.

5.5 Given the non-igneous geological environment of the study area a geomagnetic technique, fluxgate gradiometry, was also considered appropriate for detecting the types of feature mentioned above. This technique involves the use of hand-held magnetometers to detect and record anomalies in the vertical component of the Earth's magnetic field caused by variations in soil magnetic susceptibility or permanent magnetisation; such anomalies can reflect archaeological features.

Field methods

5.6 A 20m grid was established across the survey area and related to the Ordnance Survey National Grid using a Leica GS15 global navigation satellite system (GNSS) with real-time kinematic (RTK) corrections typically providing 10mm accuracy.

5.7 Measurements of earth electrical resistance were determined using Geoscan RM15D Advanced resistance meters and MPX15 multiplexers with a mobile twin probe separation of 0.5m. A zig-zag traverse scheme was employed and data were logged in 20m grid units. The instrument sensitivity was 0.1ohm, the sample interval was 0.5m and the traverse interval was 1m, thus providing 800 sample measurements per 20m grid unit.

5.8 Measurements of vertical geomagnetic field gradient were determined using Bartington Grad601-2 dual fluxgate gradiometers. A zig-zag traverse scheme was employed and data were logged in 20m grid units. The instrument sensitivity was nominally 0.03nT, the sample interval was 0.25m and the traverse interval was 1m, thus providing 1,600 sample measurements per 20m grid unit.

5.9 Data were downloaded on site into a laptop computer for initial processing and storage and subsequently transferred to a desktop computer for processing, interpretation and archiving.

Data processing

5.10 Geoplot v.3 software was used to process the geophysical data and to produce both continuous tone greyscale images and trace plots of the raw (minimally processed) data. The greyscale images and interpretations are presented in Figures 2-4; the trace plots are provided in Figure 5. In the greyscale images, high resistance and positive magnetic anomalies are displayed as dark grey, while low resistance and negative magnetic anomalies are displayed as light grey. Palette bars relate the greyscale intensities to anomaly values in nanoTesla/ohm as appropriate.

5.11 The following basic processing functions have been applied to the resistance data:

clip	clips data to specified maximum or minimum values; to eliminate large noise spikes; also generally makes statistical calculations more realistic
add	adds or subtracts a positive or negative constant value to defined blocks of data; used to reduce discontinuity at grid edges
despike	locates and suppresses spikes in data due to poor contact resistance
interpolate	increases the number of data points in a survey to match sample and traverse intervals; in this instance the data have been interpolated to 0.25m x 0.25m intervals

5.12 The following basic processing functions have been applied to the geomagnetic data:

clip	clips data to specified maximum or minimum values; to eliminate large noise spikes; also generally makes statistical calculations more realistic
zero mean traverse	sets the background mean of each traverse within a grid to zero; for removing striping effects in the traverse direction and removing grid edge discontinuities
interpolate	increases the number of data points in a survey to match sample and traverse intervals; in this instance the data have been interpolated to 0.25m x 0.25m intervals

Interpretation: anomaly types

5.13 Colour-coded geophysical interpretations are provided. Two types of resistance anomaly have been distinguished in the data:

high resistance	regions of anomalously high resistance, which may reflect foundations, tracks, paths and other concentrations of stone or brick rubble
low resistance	regions of anomalously low resistance, which may be associated with soil-filled features such as pits and ditches

5.14 Three types of geomagnetic anomaly have been distinguished in the data:

positive magnetic	regions of anomalously high or positive magnetic field gradient, which may be associated with high magnetic susceptibility soil-filled structures such as pits and ditches
negative magnetic	regions of anomalously low or negative magnetic field gradient, which may correspond to features of low magnetic susceptibility such as wall footings and other concentrations of sedimentary rock or voids

dipolar magnetic	paired positive-negative magnetic anomalies, which typically reflect ferrous or fired materials (including fences and service pipes) and/or fired structures such as kilns or hearths

Interpretation: features

5.15 A colour-coded archaeological interpretation plan is provided.

5.16 Large dipolar magnetic anomalies around the edges of the geomagnetic survey reflect adjacent fences, gates, sheds, houses and vehicles in the car park to the south.

5.17 A chain of intense dipolar magnetic anomalies has been detected across the southern part of the site, aligned north-east/south-west. This corresponds to a linear low resistance anomaly and almost certainly reflects a ferrous pipe.

5.18 Many small, strong dipolar magnetic anomalies have been detected in the geomagnetic survey. There is a particularly high concentration of such anomalies in the north and west of the field, which broadly corresponds to an area of high electrical resistance. The geomagnetic anomalies almost certainly reflect items of near-surface ferrous and/or fired debris, such as horseshoes and brick fragments, for example, and in most cases have little or no archaeological significance. Several ferrous items were noted on the ground and removed prior to survey, however, a high level of magnetic 'noise' was still apparent across the site when trying to calibrate the fluxgate gradiometer.

5.19 Although the resistance data collection was hampered by very dry ground conditions, providing both very high and poor contact resistance values, it has been possible to remove many of the spurious readings to give a good general view of earth resistance variation across the site.

5.20 A large area of high resistance has been recorded across much of the north-central part of the field, broadly corresponding to the mound and the higher ground there, but with linear high resistance anomalies extending southwards. Two of these are parallel, approximately 3-4m apart, and head south-south-east from the mound; these correspond to a slight earthwork noted on the ground, which has been tentatively interpreted as a ramp built for robbing stone from the disused chapel (Archaeological Services 1995). These high resistance anomalies also correspond to the stone rubble deposits excavated in Area 2 of the 1995 evaluation.

5.21 Another band of high resistance values, detected approximately 10m to the west, probably reflects a stone rubble layer about 5m wide. Both this and the above anomalies appear to reflect man-made access routes up to the chapel site, either contemporary with, or subsequent to, the chapel's use.

5.22 Many high resistance anomalies were recorded over the mound and chapel area. These are generally quite broad and irregular in shape and probably reflect rubble rather than wall footings, although wall footings could survive *in situ* beneath the rubble, if not robbed-out. Some of these anomalies form a rectilinear arrangement on the mound and correspond to low earthwork banks noted on the ground. The 1995 evaluation recorded a linear dump of rubble parallel to but outside the base of the east wall of the chapel, and so it could be that the rubble spreads and banks

here do not indicate the actual wall positions but are external to the walls. Some narrower high resistance anomalies have also been detected over the general mound area, which could possibly reflect wall foundations.

5.23 A circular area of high resistance has been detected in the north-eastern part of the site. The shape is quite regular and measures 8-9m in diameter, however, it appears to extend from the top of the mound onto the eastern slope and so is more likely to reflect rubble than a circular structural feature. Area 3 from the 1995 evaluation is contained within this circular area, and the stone areas recorded within the trench broadly correspond to high resistance anomalies detected in this survey.

5.24 Additional possible high resistance lineations were detected on the southern and western flanks of the mound, which are considered less likely to reflect wall footings due to their locations.

5.25 Two discrete, very high resistance anomalies, which were detected immediately south of the chapel on the southern edge of the mound, correspond to two very strong magnetic anomalies. The eastern anomaly measures 4-5m across and corresponds to a slight earthwork noted on the ground, and the western anomaly measures up to 3m across. Unlike the other high resistance anomalies, these may reflect burnt areas or dumps of burnt/fired materials. The evaluation trench just to the north recorded 'fire debris' within the chapel, above the inferred floor level.

5.26 A number of small negative magnetic anomalies are apparent in the same area as the probable dumps of burnt materials described above. Although this type of anomaly could reflect limestone, most of the anomalies here are the negative components of dipolar anomalies. Whilst they appear to form a rectangular arrangement on the slope south of the mound, the similarity to a small building is probably apparent rather than real. Nevertheless, there is some resistance evidence for walls in this area and so the magnetic anomalies are not completely discounted.

5.27 As well as the more subtle resistance anomalies which were detected beyond the top of the mound, some weak positive magnetic anomalies were also detected. The weak positive magnetic anomalies could reflect soil-filled ditches or gullies, as could two low resistance anomalies in the south of the area and a further two on the western side of the mound. The low resistance anomalies could also reflect trenches for walls, either robbed or not built.

6. Conclusions

6.1 Geomagnetic and earth resistance surveys have been undertaken over the presumed site of St Botolph's Chapel in Frosterley, Weardale, as part of the North Pennines AONB 'Altogether Archaeology' project.

6.2 An area of relatively high resistance was detected over the mound and much of the northern part of the field. This may be due, in part at least, to better drainage here, but much will almost certainly be due to the presence of near-surface rubble; some bands of stone rubble were evident on the surface. Within this general area it is possible to identify broad, irregular bands of particularly high resistance which almost certainly reflect deposits of stone rubble; these may overlie or be adjacent to

the former walls of the chapel. Narrow high resistance anomalies could reflect *in situ* wall footings.

6.3 Some additional narrow high resistance anomalies, and occasional negative magnetic anomalies, on the southern and western slopes of the mound could possibly reflect further stone features and possible wall footings.

6.4 Two discrete anomalies on the southern edge of the mound probably reflect fired or burnt materials.

6.5 Two probable stone features were also detected aligned broadly north-south in the southern half of the field. The western feature may comprise a stone surface such as a track, while the eastern feature appears to be a stone-built ramp or track between the chapel site and the road. This latter feature can be discerned on the ground.

6.6 Several more subtle anomalies in both datasets could reflect the remains of soil-filled ditches and gullies, or wall trenches.

6.7 A ferrous pipe has almost certainly been detected across the southern part of the site.

7. Sources

Archaeological Services 1995 *St Botolph's Chapel, Frosterley: Trial Excavations*. Unpublished report **304**, Archaeological Services Durham University

David, A, Linford, N, & Linford, P, 2008 *Geophysical Survey in Archaeological Field Evaluation*. English Heritage

Gaffney, C, Gater, J, & Ovenden, S, 2002 *The use of geophysical techniques in archaeological evaluations*. Technical Paper **6**, Institute of Field Archaeologists

IfA 2011 *Standard and Guidance for archaeological geophysical survey*. Institute for Archaeologists

Schmidt, A, & Ernenwein, E, 2011 *Guide to Good Practice: Geophysical Data in Archaeology*. Archaeology Data Service

ARCHAEOLOGICAL SERVICES
DURHAM UNIVERSITY

on behalf of
Altogether Archaeology

NORTH PENNINES
Area of Outstanding Natural Beauty

St Botolph's Chapel
Frosterley
County Durham

geophysical survey
report 3215

Figure 1: Site location

site location

0 1km

scale 1:25 000 for A4 plot

ARCHAEOLOGICAL SERVICES
DURHAM UNIVERSITY

on behalf of
Altogether Archaeology

NORTH PENNINES
Area of Outstanding Natural Beauty

magnetic survey (A)
-20 nT 20

resistance survey (B)
40 ohm 110

0 25m
scale 1:500 for A3 plot

St Botolph's Chapel
Frosterley
County Durham

geophysical survey
report 3215

Figure 2: Geomagnetic and resistance surveys

A

B

14
5
k
370
TCB
Car Park
2
1
1
025
11
15
178.3m

ARCHAEOLOGICAL SERVICES
DURHAM UNIVERSITY

on behalf of
Altogether Archaeology

NORTH PENNINES
Area of Outstanding Natural Beauty
GLOBAL GEOPARKS NETWORK

magnetic survey (A)
dipolar magnetic anomaly
positive magnetic anomaly
negative magnetic anomaly

resistance survey (B)
high resistance anomaly
low resistance anomaly

0 25m
scale 1:500 for A3 plot

St Botolph's Chapel
Frosterley
County Durham

geophysical survey
report 3215

Figure 3: Geophysical interpretations

A

B

14
5
k
370
TCB
Car Park
2
1
1
11
15
178.3m
025

ARCHAEOLOGICAL SERVICES
DURHAM UNIVERSITY

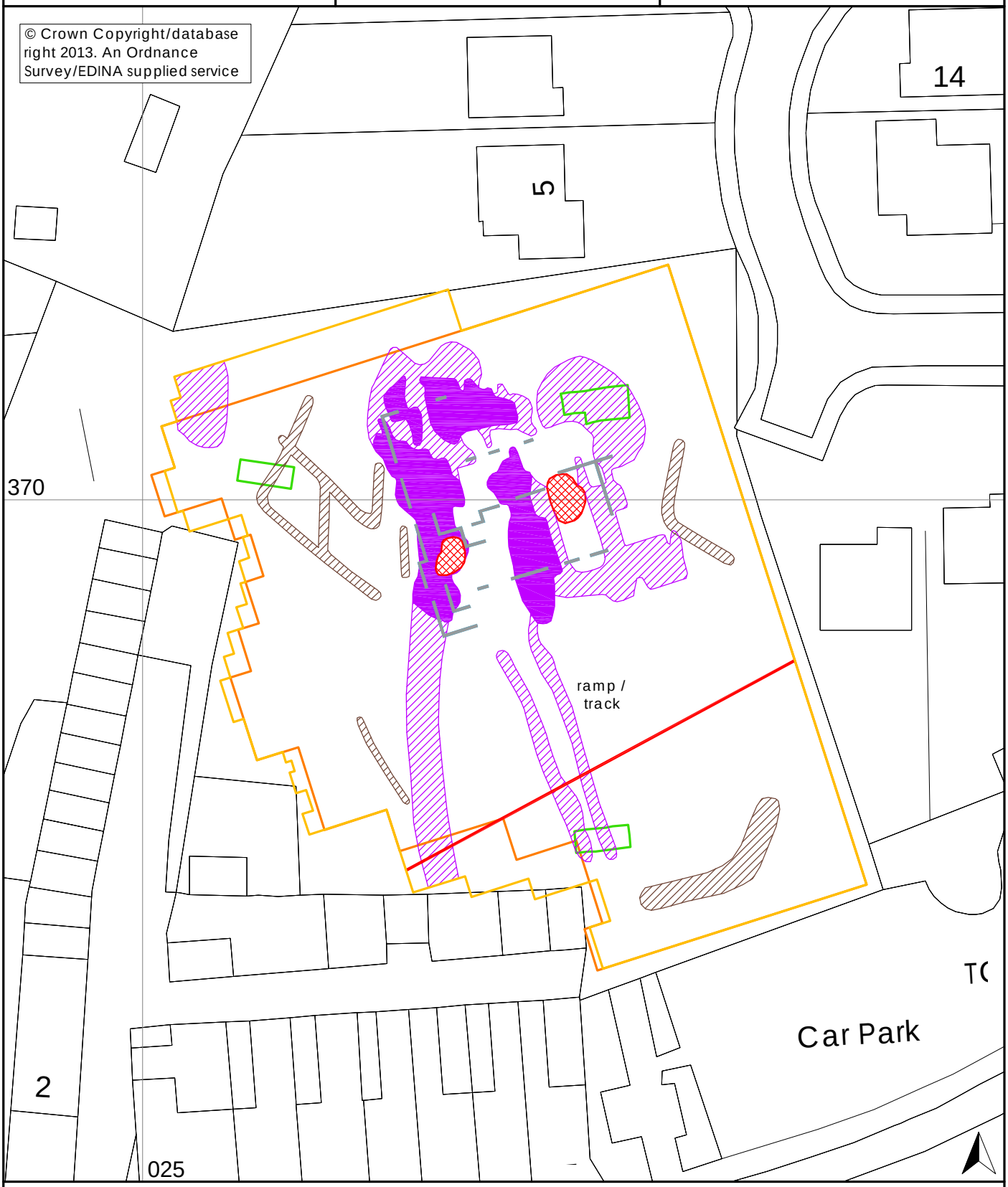
on behalf of
Altogether Archaeology

NORTH PENNINES
Area of Outstanding Natural Beauty

St Botolph's Chapel
Frosterley
County Durham

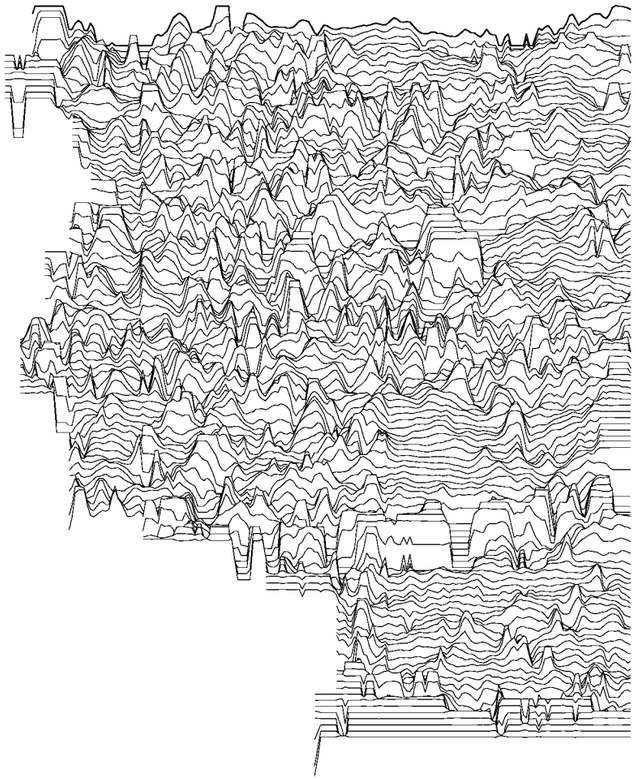
geophysical survey
report 3215

Figure 4: Archaeological interpretation



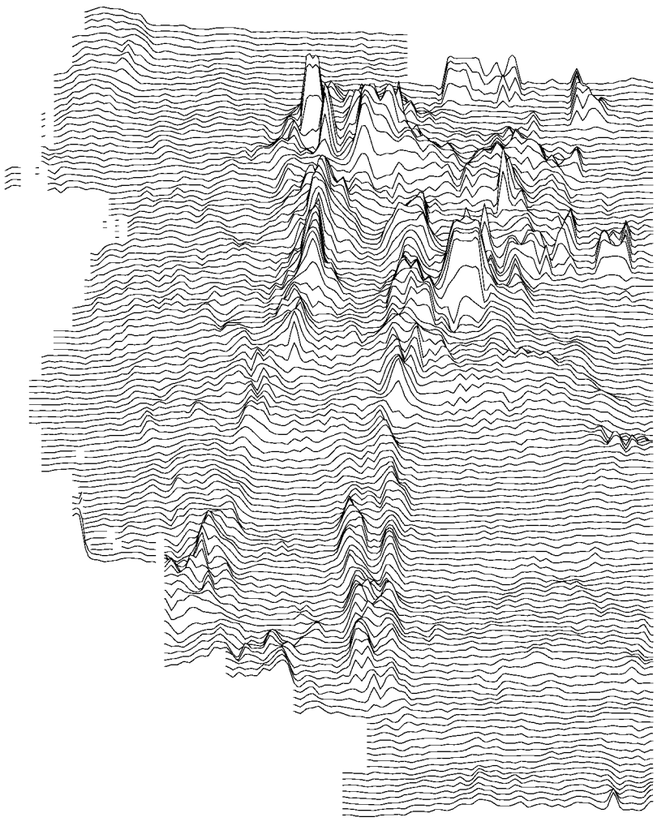
Geomagnetic survey

60.00nT/cm



Resistance survey

122.70ohm/cm



ARCHAEOLOGICAL SERVICES
DURHAM UNIVERSITY

on behalf of
Altogether Archaeology

NORTH PENNINES
Area of Outstanding Natural Beauty

St Botolph's Chapel
Frosterley
County Durham

geophysical survey
report 3215

Figure 5: Trace plots of geomagnetic and resistance data

0 25m
scale 1:500 for A3 plot